9-2021

Correlates of Problematic Gambling as Correlates of Problematic Video Game Use

Hyo Jin Lee

LOMA LINDA UNIVERSITY
School of Behavioral Health
in conjunction with the
Faculty of Graduate Studies

Correlates of Problematic Gambling as Correlates of Problematic Video Game Use

by

Hyo Jin Lee

A Dissertation submitted in partial satisfaction of
the requirements for the degree of
Doctor of Philosophy in Psychology

September 2021

Each person whose signature appears below certifies that this dissertation in his/her opinion is adequate, in scope and quality, as a dissertation for the degree Doctor of Philosophy.

____, Chairperson
Holly E. R. Morrell, Associate Professor of Psychology

____
Colleen A. Brenner, Associate Professor of Psychology

____
Whitney Brown, Licensed Clinical Psychologist

____
Patricia Flynn, Associate Professor of Psychology

CONTENTS

ABSTRACT OF THE DISSERTATION

Correlates of Problematic Gambling as Correlates of Problematic Video Game Use

by

Hyo Jin Lee

Doctor of Philosophy, Graduate Program in Psychology
Loma Linda University, September 2021
Dr. Holly E. R. Morrell, Chairperson

Problematic video game use (PVGU), or addiction-like use of video games, affects a significant portion of the population and is associated with various negative physical and mental health problems. Given existing research regarding PVGU and gambling disorder, as well as the recent convergence of gambling and video gaming activities, studying correlates of gambling disorder in the context of PVGU may help identify novel correlates of PVGU that can be used to improve assessment and intervention. The aim of the current study was to examine correlates of gambling disorder, such as gaming fallacies and perceived locus of control, as potential predictors of PVGU using structural equation modeling. Data were collected through an online survey comprising measures of PVGU and various potential correlates of PVGU. The sample included 3,481 adults between the ages 18 and 74 (*M* = 25.08, *SD* = 7.02; 79.8% cisgender male; 11.1% Hispanic; 77.4% Caucasian, 8.5% Asian or Asian American, 5.4% identifying as mixed race, 5.2% identifying as Other, 2.2% Black or African American, 1.1% Native American or Alaskan Native, and 0.4% Native Hawaiian or other Pacific Islander). The final model fit the data very well, χ^2 (69) = 278.846, $p < .05$; RMSEA = 0.034 (90% CI [.030, .038]); CFI = 0.959; SRMR = .027. As hypothesized,

Gaming Fallacies, Locus of Control, and participants' video game use all had significant, positive relationships with PVGU. The large effect size of the combination of predictors suggests a clinically significant relationship, and considering these multiple correlates in combination may result in more effective assessment and treatment of PVGU.

CHAPTER ONE

INTRODUCTION

Video Games and Mental Health

The video game industry has enjoyed a rapid growth ever since the first video game for recreational purposes was created in the 1950s (Brookhaven National Laboratory, 2008). The global video game market was valued at $162.32 billion in 2020, and this is expected to reach $295.63 billion by 2026 (Mordor Intelligence, 2021). In terms of video game users,

64% of adults and 70% of children in the US are video game players, totaling 214.4 million video game players (Entertainment Software Association, 2020). The average age range of a video game player is between 35 and 44 years old, with 21% being under 18 years old, and 15% being over 55 years old. Most video game players surveyed by Entertainment Software Association (2020) believe that video games have a positive impact on their lives, such as providing mental stimulation or stress relief.

Given the widespread use of video games, it is important to study the effects of playing video games. Research suggests that, depending on the type of video game, video game use play may improve certain skills such as visual spatial skills and problem-solving skills (Schmidt & Vandewater, 2008). For example, Adachi and Willoughby (2013) conducted a longitudinal study on problem solving skills of adolescents who played strategic games and adolescents who played fast-paced games. Through a four-wave autoregressive cross-lagged path analysis, they found that the frequency of playing strategic games such as role-playing games significantly predicted self-reported problem solving skills over time, which significantly predicted higher academic grades over time.

Playing fast-paced games such as fighting, action, and racing games did not significantly predict self-reported problem solving skills over time. Video games are also being studied for therapeutic use. In a literature review of non-typically developing children and adolescents, Page et al. (2017) found that using video games that involve movements of body limbs during play led to significant improvements in one or more gross motor skills. Specifically, studies reported significant improvements in balance, coordination, ball skills, and locomotor skills. In addition to improving motor skills, video games can be used as a user-friendly medium of feedback in a neurofeedback system to help patients manage ADHD symptoms (Butnik, 2005).

In terms of benefits in adults, video game use is associated with improved cognitive function (Maillot et al., 2012; Stroud & Whitbourne, 2015). Maillot et al. (2012) developed an active video-game training program that offers physiological and cognitive challenges, and measured the pretest and posttest cognitive functions of adults between the ages of 65 and 78 years. They found that those who had gone through the video game training program had made improvements on executive control and processing speed tasks. In addition, Stroud and Whitbourne (2015) used Bejeweled Blitz, a popular match-3 casual video game, to test attentional processes in undergraduate students. Individuals who played 30 rounds of the game scored significantly higher in a visual search task than individuals who did not play the game, though individuals who played ten rounds did not score higher than individuals who did not play the game, suggesting that the amount of practice was significant.

However, video game use is also associated with negative outcomes as well. Existing literature suggests that playing violent video games is associated with increases in aggressive behavior over time (Calvert et al., 2017). Specifically, violent video game use has been associated with aggressive behavior, cognitions, and affect, as well as increased desensitization to violence and decreased empathy. A study with nine to 18 year old participants also found that individuals who played at least some violent video games in the past year were four times more likely to have carried a weapon to school in the past month (Ybarra et al., 2014). Emotional well-being is another area of concern associated with video game use (Maras et al., 2015; Melchior et al., 2014). A survey of 2,482 Canadian students in grades 7 through 12 found that total screen time, which includes time spent watching TV, playing video games, and using the computer, was significantly related to depressive symptoms and anxiety symptoms (Maras et al., 2015). Furthermore, time spent playing video games was significantly related to more severe symptoms of depression and anxiety. In terms of the adult population, Melchior et al. (2014) found that regular video game use, defined as playing video games more than once a week, was associated with being overweight, though regular Internet use, defined as more than two hours of Internet use per day, was not associated with being overweight.

Problematic Video Game Use

Another negative outcome associated with video game use is the potential for addiction. Addiction has been defined by Goodman (1990) as a process in which a behavior, which is either pleasurable or allows escape from discomfort, is engaged in a way that is out of control, and is maintained despite significant negative consequences. Di Chiara (1998) describes a motivational learning hypothesis in the context of substance addiction: an addictive stimulus causes repetitive release of dopamine in the mesolimbic system, leading to strengthening of the stimulus-reward learning process. Functional magnetic resonance images obtained during video game play indicate activation in the mesocorticolimbic system (Hoeft et al., 2008), suggesting that addiction-like use of video games may function similarly to substance addiction. This is further supported by the long term changes in the reward system for individuals with addiction-like use of video games that are similar with individuals with substance addictions (Karim & Chaudhri, 2012).

While addiction has traditionally been studied in regard to the use of substances (i.e., chemical dependency), video game use that is out of control and that occurs despite negative consequences also qualifies as a form of behavioral addiction. The Diagnostic and Statistical Manual of Mental Disorders – 5th edition (DSM-5; American Psychiatric Association, 2013) lists internet gaming disorder under the section “Conditions for Further Study.” The DSM-5 notes that there are behavioral disorders – including problematic use of video games – that share similarities with substance use disorders, as well as with gambling disorder, a behavioral addiction that is recognized as a formal diagnosis in the DSM-5. Furthermore, “gaming disorder” was recently added to the 11th Revision of the International Classification of Diseases (ICD-11; World Health Organization [WHO], 2020) in mid-2018. ICD-11 defines gaming disorder as “a pattern of persistent or recurrent gaming behavior.” Along with gambling disorder, gaming disorder is classified under “disorders due to addictive behaviors,” a category for distress or dysfunctions “as a result of repetitive rewarding behaviors” excluding the use of addictive substances (WHO, 2020).

The current literature is divided on how to define problematic use of video games, the appropriate name for this problem, and the diagnostic criteria to measure it. Some have employed the diagnostic criteria for pathological gambling from the Diagnostic and Statistical Manual of Mental Disorders – 4th edition (DSM-IV; American Psychiatric Association, 2000) and have adapted them for video games (Coëffec et al., 2015; Gentile et al., 2011). Others use a range of criteria to measure problematic use of video games, from the quantity of hours of video games played per day (Wenzel et al., 2009), to more specific questionnaires covering a number of areas of problematic use of video games, such as loss of control, mood alteration, and withdrawal symptoms (Van Rooij et al., 2014; Walther et al., 2012). The proposed criteria listed in the DSM-5 are different from these aforementioned criteria, and the criteria listed in the ICD-11 differ from the proposed criteria of internet gaming disorder by DSM-5, notably by qualifying both online and offline games as part of the gaming disorder diagnosis (WHO, 2018). That is, there is a variety of ways that problematic use of video games can currently be defined and measured. In addition, the name of the problematic gaming behavior varies with each of these sets of criteria, including internet gaming disorder (American Psychiatric Association, 2013), problematic video gaming (Van Rooij et al., 2014), pathological video game use (Gentile et al., 2011), and gaming disorder (World Health Organization, 2018). In light of the varying definitions and criteria that currently exist, this paper will use the term problematic video game use (PVGU) to refer to the problematic use or addiction to video games.

PVGU affects a significant portion of the population, but the exact prevalence rates vary depending on how PVGU is measured. According to a meta-analysis of 30 published articles and three doctoral dissertations, overall prevalence of PVGU appears to be about 6.0% (Ferguson et al., 2011). However, the meta-analysis also noted the heterogeneity between studies that were included in the meta-analysis. Specifically, studies that measured PVGU by using adapted versions of measures of pathological gambling tended to yield a higher prevalence (8.9%). Studies that focused on how video game use interferes with one's daily life tended to yield a lower prevalence (3.1%). With these caveats in mind, more specific prevalence rates include 8.5% of individuals between 8-18 years of age in the U.S. (Gentile, 2009), 7.5% in Taiwan (Ko et al., 2007), 11.9% in Germany (Grüsser et al., 2007), 7.6-9.9% in Singapore (Gentile et al., 2011), and 8% in an online survey (Porter et al., 2010). Negative consequences of PVGU include general health problems (Wenzel et al., 2009), mental health problems such as depression and anxiety (Gentile et al., 2011; Van Rooij et al., 2014; Wenzel et al., 2009), and problems with school work, jobs, and close relationships (Gentile et al., 2011; Van Rooij et al., 2014; Wenzel et al., 2009). Given the widespread use of video games, prevalence of PVGU, and the negative consequences of PVGU, it is important to identify factor that contribute to PVGU.

Using Correlates of Gambling as Correlates of PVGU

Evidence suggests that addictions tend to be positively correlated with each other (Istvan & Matarazzo, 1984; Walther et al., 2012), and McBride and Derevensky (2016) found this to be true for problematic gambling and PVGU. McBride and Derevensky (2016) found that among college students in Quebec, individuals with PVGU report a higher frequency of gambling than social gamers or non-gamers. King et al. (2012), on the other hand, found that video game use and gambling (including problematic gambling) were not significantly associated with each other. However, they also found that video game use had a significant positive relationship with gambling fallacies, or erroneous gambling-related cognitions, such as illusion of control biases (the belief that one's actions can influence the outcome of random events) and superstitious beliefs related to gambling. If individuals who play video games have gambling fallacies such as illusion of control biases and superstitious beliefs related to gambling, they may also have similar cognitions that relate to video game use. Therefore, studying gambling fallacies and other correlates of problematic gambling may help identify correlates of PVGU because of potential similarities between these two behavioral addictions.

In addition to similar cognitions of illusion of control and superstitious beliefs, there may be other similarities between PVGU and problematic gambling in that the activities themselves are becoming more similar to each other. That is, specific aspects of gambling and video game play such as additions of entertainment elements to gambling and additions of real-value rewards to video games are creating a convergence of gambling and video games (King et al., 2015). Griffiths and Auer (2013) describe several mechanisms that contribute to problematic gambling, such as short payout intervals that provide immediate rewards to promote learning, and high event frequency and short event duration that allow users to make multiple plays with little or no delay. The authors suggest that these mechanisms may be more relevant to problematic gambling than the type of gambling game that is played. Likewise, rather than the genre or the type of video games, PVGU may also be impacted by mechanisms that reinforce video game players that are similar to mechanisms that reinforce gambling.

Certain video games, mobile games in particular, utilize gambling mechanics as an important feature of the game play. “Gacha” is an in-game mechanism used in free-to-play games that has its roots in random capsule toy machines called “gashapons” (Klepek, 2017). A player inserts money into a gashapon and turns a lever, and then the machine yields a capsule that reveals a random toy as a reward. However, the player does not know what toy they will get beforehand, and may play multiple rounds in order to increase their chances of getting the desired toy. Similarly, gacha games allow users to spend either in-game currency or real-life currency to have a chance at obtaining a random reward. This process is colloquially called a “pull,” as one is “pulling” a reward from a large pool of potential rewards. The reward from doing a gacha “pull” can be aesthetic (e.g., cosmetic changes to the playable character or equipment) or functional (e.g., equipment and playable characters that increase the player’s chance of winning a match or making progress through the game), but regardless of the type of the rewards offered, the player does not know the specific reward they will receive from their next pull. While gashapons and gacha games originate from Japan, many Western video games have begun to employ similar mechanisms under the label “loot boxes,” which can be found in a variety of popular games today.

In addition to this basic gacha mechanism of random rewards, gacha games employ a variety of other gambling mechanisms discussed by Griffiths and Auer (2013). For example, given that they are computerized, Gacha games offer an extremely short payout interval by providing the reward as soon as a pull is made. In addition, event frequency is high and event duration is short; each gacha pull occurs in a very short amount of time, and since there is little to no wait time in between pulls, the number of events that are available for making gacha pulls are much higher than some gambling activities such as lottery. Given that these mechanisms may be important contributors to problematic gambling, it is notable that more and more games being developed and published today are implementing such mechanisms as part of the gameplay. The fact that video games and gambling activities may be becoming more similar also gives further weight to studying gambling-related cognitions and other correlates of problematic gambling as a way to identifying correlates of PVGU. In light of such similarities, examining predictors of gambling disorder in the context of video games may help identify predictors of PVGU, and ultimately additional targets for prevention and intervention.

Potential Correlates of PVGU

One correlate of problematic gambling that can be studied in the context of PVGU is parents' gambling behavior. Parents' gambling behavior is associated with their adolescent's gambling behavior (Griffiths, 2010). Browne and Brown (1994) found that college students whose parents gambled on lotteries were more likely to gamble on lotteries themselves, and Vachon et al. (2004) found that adolescents' gambling frequency was associated with both the frequency and the severity of the parents' gambling behavior. In addition, individuals whose gambling behavior is problematic or at risk of becoming problematic perceive their family members, siblings, and peers as engaging in problematic gambling (Hardoon et al., 2004).

Similarly, parents' video game use may be a correlate of one's video game use and PVGU. The Entertainment Software Association (2020) reports that 7% of video game players play video games with their parents, indicating that there are some parents of gamers who also play video games themselves. In addition, Jago et al. (2012) found in regard to screen-viewing time, which includes TV use, video game use, and internet use, that children whose parents reported a high quantity of screen-viewing time also reported a high quantity of screen-viewing time. However, there is no research to date that specifically examines the relationship between parents' video game use and PVGU symptomatology. In order to elucidate this relationship, the relationship between parents' video game use and the child's PVGU symptomatology must be studied. If parents' video game use is a significant correlate of the child's PVGU, then prevention, screening, and treatment interventions for PVGU may benefit from including parents of those with PVGU.

In addition to the parents' gambling behavior, siblings' gambling behavior is another potential correlate of problematic gambling behavior. Canale et al. (2017) found that high school students are more likely to be problem gamblers or at risk of being problem gamblers if they have older siblings who gamble. Gupta and Derevensky (1997) also found that 53% of children who gambled did so with their siblings. In contrast, Fortune et al. (2013) conducted a study with frequent gamblers (i.e., individuals who gambled at least weekly), and found that participants' gambling severity was not associated with the siblings' gambling behavior.

While the research on sibling's gambling behavior and problematic gambling behavior appears to be mixed, there is no research to date that examines the relationship between siblings' video game use and PVGU symptomatology. It is unknown whether there are differences in PVGU symptomatology between gamers whose siblings play video games and gamers whose siblings do not play video games. However, if siblings' video game use is a significant correlate of PVGU, siblings may be included in prevention, screening, and treatment interventions for PVGU to improve effectiveness; thus, it is important to study how PVGU is related to siblings' video game use.

Peers' gambling behavior may also play a role in an individual's gambling behavior. Fortune et al. (2013) found that an individual's five closest friends' gambling behavior is significantly associated with the participant's gambling severity. Individuals who have friends that play the lottery spend more money than individuals who do not have friends that play the lottery (Browne & Brown, 1994). Finally, a study of 477 children between the ages of 9 and 14 found that of those who gambled, 40% did so with their parents, 53% did so with their siblings, and 75% did so with friends (Gupta & Derevensky, 1997). These categories are not mutually exclusive, since the participants often gambled with multiple individuals.

Likewise, a significant portion of video game players play video games with peers. Specifically, the Entertainment Software Association (2020) reports that 42% of gamers play video games with friends. In addition, Wu et al. (2016) found that peer influence, including peer use of video games, has a significant positive relationship with the severity of PVGU of the participants. It appears that peer use of video games may play a role in an individual's video game use, and PVGU symptomatology; however, studies that examine the relationship between peer use of video games and PVGU symptomatology are lacking in volume.

Video game players are often exposed to other video game players. The Entertainment Software Association (2020) reports that 65% of video game players play with others, and also reported that adult video game players spend on average 6.6 hours a week playing with others online, and 4.3 hours a week playing with others in person. The people with whom they play include friends, family members and spouses, and "online only" friends. Given that video game players are often in contact with other video game players in this way, it is important to study whether this contact normalizes video game use or otherwise plays a role in PVGU. In addition, video game players, similar to gamblers, play video games with multiple groups of individuals. To date, no research simultaneously examined the role of parents' video game use, siblings' video game use, and peers' video game use on PVGU symptomatology. Therefore, parents, siblings, and peer video game use will all be tested as correlates of PVGU in the current study.

Another correlate of problematic gambling that can be studied in the context of PVGU is the age of initiation of gambling (i.e., the time when an individual gambled for the first time). Age of initiation of substances is associated with developing substance use problems later in life (Grant & Dawson, 1998; Hingson et al., 2006). Studies examining age of initiation and gambling found that this may be true for problematic gambling as well (Slutske et al., 2014). Lynch et al. (2004) compared adolescent, early-onset adult gamblers (i.e., adults who started gambling before they were 18 years old) to adult-onset gamblers (i.e., adults who started gambling after they were at least 18 years old). They found that adolescent gamblers were significantly more likely to have experienced problematic gambling than adult-onset gamblers. In addition, Kessler et al. (2008) found that the age of initiation was significantly lower for those who later developed problematic gambling behavior compared to those who did not develop problematic gambling behavior later in life. As age of gambling initiation suggests development of problematic gambling, age of video game initiation may be also related to development of PVGU.

Gambling fallacies, which are erroneous gambling-related cognitions, are also correlates of problematic gambling. Leonard et al. (2015) describe six gambling fallacies that suggest misconceptions regarding the random and uncontrollable nature of gambling, or misunderstandings regarding statistical knowledge. The hot hand fallacy refers to the belief that a winning streak suggests future wins, despite the random nature of the outcome. The Monte-Carlo fallacy, on the other hand, predicts that an opposite outcome will follow a series of a certain outcome in order to "even things out." Belief that luck is dispositional refers to the belief that certain things such as numbers are lucky, and that they are favored over non-lucky things. Illusion of control, as described earlier, is the belief that one's actions can influence the outcome of random events. Insensitivity to sample size refers to the belief that deviant outcomes are just as likely in large samples as they are for small samples. For example, if a player playing a game designed to yield a 50% win rate experienced an 80% win rate over five rounds, the player might still expect an 80% win rate over 500 rounds. Base rate neglect refers to the tendency to inaccurately estimate the likelihood of an event based on the available instances of the event in one's memory. These fallacies are common among gamblers and problem gamblers (Leonard & Williams, 2016; Moore & Ohtsuka, 1999). Moore and Ohtsuka (1999) found that those who gambled more believed that they had more control over their gambling behavior. A greater illusion of control over the outcome of gambling, as well as a stronger belief in being able to beat the system, are also positively associated with problematic gambling. In a five-year longitudinal study, Leonard and Williams (2016) used a measure that assessed all of the aforementioned fallacies, and found that gambling fallacies significantly predicted problematic gambling.

These gambling-related beliefs are fallacies because the outcome of gambling activities are designed to be at least partially, if not entirely, random and uncontrollable. A poker player placing bets may have some control over the in-game decisions, but has no control over which cards are dealt to them and to other players. A lottery player may increase their chances of winning by purchasing multiple lottery tickets, but has no control over what the winning numbers are. The gambling fallacies occur because people tend to believe that random outcomes are predictable, that there are patterns, and that they have control over the outcomes (Brevers & Noël, 2013; Moore & Ohtsuka, 1999). Video game play is similar to gambling in that the game outcome is also at least partially random and uncontrollable. Video games can include random components that affect gameplay. In addition to gacha pulls and loot boxes described earlier, various actions that yield in-game rewards, such as defeating enemies or completing a mission, may not always yield the same rewards. This encourages players to continue gameplay until the desired outcome is achieved. While player skill does influence video game outcomes to various degrees, the random components over which the player does not have control ensure that video game outcomes are at least partially random and uncontrollable. Strong beliefs that video game outcomes are predictable, that there are patterns, and that players have control over the outcomes may lead to repeated attempts to achieve desired outcomes, regardless of the odds. Therefore, the degree to which the player adheres to video game-related fallacies may be related to PVGU.

Locus of control refers to individuals' beliefs in their ability to influence events and outcomes through their actions (Rotter, 1966). While the illusion of control, one of the gambling fallacies, refers to the erroneous belief in one's control over random and unpredictable *outcomes*, locus of control is relevant to a different aspect of gambling-related behaviors in that locus of control can determine an individual's perspective on whether they have control over their *gambling behavior* (e.g., amount of money to spend, and whether to stop gambling or not). Locus of control may also determine an individual's belief about whether their gambling-related skill matters to the outcome at all, and if so, to what degree. Locus of control appears to have varied relationships with gambling behavior. Moore and Ohtsuka (1999) found that a greater internal locus of control in terms of the player's control over their own gambling behavior was associated with higher frequency of gambling. In contrast, Browne and Brown (1994) found that those with an external locus of control were more likely to have parents who were gamblers, and as previously discussed, having parents who gamble is associated with the child's gambling behavior (Griffiths, 2010). Zhou et al. (2012) found that the effect of belief in luck or skill (which may be suggestive of the player's locus of control) on gambling behaviors varied depending on the type of gambling activity, which may help explain variation in results across studies. Similar to gambling, video game play may also be affected by the player's beliefs regarding their ability to control the amount of money they spend, whether to stop playing video games or not, and whether their video game skill matters to the outcome of the game. It may be beneficial to explore how locus of control may be related to PVGU, both directly and indirectly through parental use of video games.

The possible correlates of PVGU discussed thus far are originally studied in the context of problematic gambling. In addition to these correlates, the amount of video game use and its relationship with PVGU will also be examined. The amount of video game use can be measured by both quantity of video game use and the frequency of video game use. Quantity of video game use refers to how much time an individual spends in total playing video games. Frequency of video game use refers to how often an individual plays video games. High quantity and frequency of video game play may suggest a behavior that is or is at risk of becoming out of control. While a greater amount of video game use by itself does not meet the proposed criteria of internet gaming disorder, research shows that individuals with PVGU spend more time on video games than individuals without PVGU (Coëffec et al., 2015). Additionally, Ream et al. (2011) found that the number of days spent playing video games in the last 30 days was positively associated with PVGU.

Finally, money spending behavior and its relationship with PVGU will be examined as another way to measure video game use. Paik et al. (2017) found that participants with PVGU symptomatology spent more money on games. However, a different study measured not only the amount of money spent on games, but also the frequency of money spent on video games, as well as the length of time one had been spending money on video games (Wang et al., 2014). In this study, PVGU was significantly associated with frequency of money spent on video games, as well as length of time one had been spending money on video games, but it was not significantly associated with the amount of money spent on video games. The current study will measure money spending behavior through the average amount of money spent on video games per week.

Aim and Hypothesis

The aim of the current study was to explore the relationships among contributing factors to PVGU. PVGU is associated with a number of negative consequences, but research on video games and PVGU is sparse. Known predictors of gambling disorder are yet to be tested on PVGU, and investigating these predictors in the context of video games may help guide both research on and interventions for PVGU. We hypothesized that parents', siblings', and peer video game use; age of initiation; gaming fallacies; locus of control; and video game use are all associated with PVGU. Specifically, we hypothesized that greater parents' video game use will be associated with greater PVGU symptomatology, both directly and indirectly through siblings' video game use and age of initiation. We hypothesized that greater siblings' video game use will be associated with greater PVGU symptomatology, both directly and indirectly through age of initiation. We hypothesized that greater peer video game use will be associated with greater PVGU symptomatology, both directly and indirectly through age of initiation. We hypothesized that younger age of initiation is associated with greater PVGU symptomatology, both directly and indirectly through the amount of video game use. We hypothesized that higher endorsement of gaming fallacies will be associated with greater PVGU symptomatology. We hypothesized that greater locus of control will be associated with greater PVGU symptomatology. Finally, we hypothesized that greater amount of video game use will be associated with greater PVGU symptomatology.

CHAPTER TWO

METHODS

Participants

Data were collected through an online survey that was advertised on various sub-forums on Reddit.com (e.g., r/truegaming, r/xbox360, and r/FinalFantasy), a multi-genre web content rating and discussion website. Individuals who were 18 years old or older were recruited for this study. As the survey was only available in English, only those who were fluent in the English language were able to participate.

The sample included 3,481 adults between the ages 18 and 74 (M = 25.08, SD = 7.02; 79.8% cisgender male). In terms of ethnicity, 11.1% of participants reported being of Hispanic or Latino descent. The racial breakdown was as follows: 77.4% Caucasian, 8.5% Asian or Asian American, 5.4% identifying as mixed race, 5.2% identifying as Other, 2.2% Black or African American, 1.1% Native American or Alaskan Native, and 0.4% Native Hawaiian or other Pacific Islander. The majority of the sample (51.4%) resided in the United States; the rest resided primarily in other developed countries such as United Kingdom (7.1%), Canada (6.3%), and Germany (4.3%).

In terms of employment status, 43.8% were students, 38.2% were employed full time, 11.6% were unemployed, and 6.5% were employed part time. The educational levels were as follows: 30.2% reported having completed some college, 23.2% reported obtaining an undergraduate degree, 18.0% reported obtaining a high school diploma or GED, 14.6% reported obtaining a graduate degree, 8.3% reported completing some high school, and 5.7% reported completing some graduate education. The majority of the sample were single (57.7%); 25.9% were dating, 14.9% were married, 1.1% were divorced, 0.3% were separated, and 0.1% were widowed.

Thirty-nine percent of participants reported that at least one of their parents/guardians played video games during their childhood, 4% reported that both parents played video games, and 57% reported that neither of their parents played video games. The majority of participants reported that their parents played video games one day per week or less (45.6%). Eighty-two percent of participants reported that at least one of their siblings played video games during participants' childhood, and 18% reported that none of their siblings played video games. Nearly 13% of participants reported that their sibling who played video games the most played one day per week or less, 10.2% reported two days per week, 13.8% reported three days per week, 14.0% reported four days per week, 14.3% reported five days per week, 7.8% reported six days per week, and 27.1% reported seven days per week. Ninety-six percent of participants reported that at least one of their friends played video games, and 4% said none of their friends played video games. The majority of participants reported that their friends played video games seven days per week (43.5%).

With regard to PVGU (as measured by the Young Internet Addiction Scale adapted for video game use; see description in Measures section below), 58.7% of participants provided responses consistent with "normal" (or non-problematic) video game use, 32.0% provided responses consistent with "mild addiction," 8.6% provided responses consistent with "moderate addiction," and 0.7% provided responses consistent with "severe addiction."

Measures

Demographic Variables

Participants were asked for the following demographic information: age, gender, ethnicity, race, country of residence, employment status, highest education level achieved, and marital status. See Appendix A.

PVGU

Young's Internet Addiction Scale (YIAS; Young, 1998) is a 20-item scale intended to assess Internet addiction among adults. It adapts DSM-IV criteria for pathological gambling to Internet addiction. All items are on a six-point Likert scale (0 = not at all, 1 = rarely, 2 = occasionally, 3 = frequently, 4 = often, and 5 = always), and the scores are combined to form a total score that ranges between 0 and 100. Scores between 0 and 30 indicate a normal level of Internet use. Scores between 31 and 49 indicate a mild level of Internet addition. Scores between 50 and 79 indicate a moderate level of Internet addiction. Scores between 80 and 100 indicate a severe level of Internet addiction. For this study, all uses of the word "Internet" were replaced with "video game(s)" to adapt the questionnaire for measuring video game addiction. Example items include "How often do you prefer the excitement of video games to intimacy with your partner?" and "How often does your job performance or productivity suffer because of playing video games?" See Appendix B.

Widyanto and McMurran (2004) found that the YIAS comprises six factors: salience, excess use, neglect of work, anticipation, self-control, and neglect of social life. They found that internal reliability varied, with Cronbach's standardized alphas ranging between 0.54 and 0.82. Also, the six factors significantly correlate with each other, with

Pearson's *r*s ranging from 0.23 to 0.62. Chan and Rabinowitz (2006) reported that the YIAS, adapted for video game use, has a reliability of 0.82. The Cronbach's alpha calculated with the current sample was 0.88.

The Problem Videogame Playing Scale (PVP; Tejeiro Salguero & Bersabé Morán, 2002) is a nine-item scale intended to assess symptoms of video game addiction. It is based on DSM-IV criteria for substance dependence and pathological gambling. Criteria measured include negative consequences; loss of control; tolerance; deception; withdrawal; escape; dysfunction in social, educational, and occupational areas; and a disregard for negative consequences. The items are dichotomous, with yes or no answers; higher total scores indicate higher levels of PVGU. Example items include "I spend an increasing amount of time playing video games" and "When I lose in a game or I have not obtained the desired results, I need to play again to achieve my target." See Appendix C.

Tejeiro Salguero and Bersabé Morán (2002) found that the internal reliability for the PVP is acceptable, with a Cronbach's alpha of 0.69. They determined that the scale had good construct validity based on a high, significant correlation between PVP score and the frequency of video game play, mean duration of video game play, and longest time per session, with Spearman's *r*s ranging between 0.52 and 0.64. The Cronbach's alpha calculated with the current sample was 0.64.

Participants' Video Game Use (VGU)

Participants were asked to provide information on their video game use frequency, video game use quantity, and money spent on video games. Specifically, they were asked the following questions: "On average, how many days out of a week do you spend playing video games?", "On average, how many hours do you spend playing video games weekly?", and "In a typical week, how much on average do you spend on video games, regardless of the type of purchases?" Participants were asked to provide their responses about amount of money spent in US dollars.

Gaming Fallacies

The Gambling Related Cognition Scale (GRCS; Raylu & Oei, 2004) is a 23-item scale intended to measure cognitions related to gambling behavior. It measures five domains of gambling-related cognitions that can distinguish individuals with problematic gambling behavior from individuals without problematic gambling behavior. The five subscales are as follows: Gambling Expectancies, Illusion of Control, Predictive Control, Inability to Stop Gambling, and Interpretive Bias. All items are rated on a seven-point Likert scale (1 = strongly disagree; 2 = moderately disagree; 3 = mildly disagree; 4 = neither agree or disagree; 5 = mildly agree; 6 = moderately agree; 7 = strongly agree), and scores are summed to form subscale scores, which are in turn summed to form a total score. The total score as well as the individual subscale scores can be used to identify problematic gambling behavior; higher scores indicate a higher number of gambling related cognitions. See Appendix D.

Raylu and Oei (2004) found that the reliability for the GRCS was high, with a Cronbach's alpha of 0.93 for the overall scale, and ranging between 0.77 and 0.91 for the five subscales. Because there were no other existing scales that were comparable to the GRCS, they assessed for concurrent validity by examining the correlations between GRCS and a number of correlates of problematic gambling such as anxiety, depression, and stress. They found that these variables were significantly correlated with the overall scale. In terms of criterion-related validity, they found that there was a significant difference between non-problematic gamblers and problematic gamblers in relation to their scores on the overall scale, as well as on each subscale (ps < 0.001). Results of multiple regression analyses suggest that both the overall score and each subscales of GRCS have good predictive validity ($r = 0.44$, $p < 0.01$ and $r = 0.52$, $p < 0.01$, respectively).

The subscales "Illusion of Control" and "Predictive Control" were adapted for this study, by changing the word "gamble" to "video game" and by making appropriate changes to make the items applicable to the subject of video games. Examples of adapted items include "Specific conditions within video games can help increase my chances of winning" (Illusion of Control) and "I have some control over predicting my video game wins" (Predictive Control). The Cronbach's alpha calculated with the current sample were 0.51 for Illusion of Control, and 0.56 for Predictive Control.

Locus of Control

The Brief Locus of Control Scale (Sapp & Harrod, 1993) is a nine-item scale intended to measure three dimensions of locus of control: Internal, Chance, and Powerful Others. It is an abbreviated version of Levenson's Multidimensional Locus of Control Scale (Levenson, 1973). Each dimension comprises three items, with each item rated on a seven-point Likert scale (1 = strongly disagree, 7 = strongly agree). Example items include "My life is determined by my own actions" (internal), "When I get what I want, it's usually because I'm lucky" (chance), and "My life is chiefly controlled by powerful others" (powerful others). See Appendix E.

Sapp and Harrod (1993) found that the internal reliability for this scale ranges from poor to acceptable, with coefficient alphas being .59, .65, and .72 for the Internal, Chance, and Powerful Others dimensions, respectively. These coefficients are higher than those for some of the other brief locus of control scales, including Lumpkin's Brief Version of Rotter's Locus of Control Scale (Lumpkin, 1985) and Lumpkin's Brief Version of Levenson's Locus of Control Scale (Lumpkin, 1988). The Cronbach's alphas calculated with the current sample were 0.71, 0.70, and 0.83 for the Internal, Chance, and Powerful Others dimensions, respectively.

Age of Initiation

To assess age of initiation of video game use, participants were asked the following question: "About how old were you when you began to play video games regularly?"

Parents' Video Game Use Frequency

Participants were asked to provide information regarding their parents' video game use frequency during the participant's childhood. Specifically, they were asked the following questions: "Before you were 18 years old, did at least one of your parents/guardians play video games?" (Yes/No/Both) and "For the parent/guardian who used to play video games the most often, how frequently on average did this person play video games before you were 18 years old?" (Response options: 1 day per week or less through 7 days per week.)

Siblings' Video Game Use Frequency

Participants were asked to provide information regarding their siblings' video game use frequency. Specifically, they were asked the following questions: "Do you have any siblings?” (Yes/No), “Before you were 18 years old, did at least one of your siblings play video games?” (Yes/No), and “For the sibling who used to play video games the most often, how frequently did this person play video games before you were 18 years old?” (Response options: 1 day per week or less through 7 days per week.)

Peer video game use frequency

Participants were asked to provide information regarding their peers’ video game use frequency. Specifically, they were asked the following questions: “Does at least one of your friends play video games?” (Yes/No), “How many of your 5 closest friends play video games?”, and “For the friend who plays video games the most often, how frequently does this friend play video games?” (Response options: 1 day per week or less through 7 days per week.)

Procedure

After receiving approval from the Internal Review Board of Loma Linda University, a survey was created through Qualtrics, a website for hosting online questionnaires that employs a sufficient level of security to prevent survey tampering. The advertisement for the survey included a basic description of the purpose of the study, the researcher’s contact information for questions, as well as the link to the survey.

The first part of the survey included information regarding the purpose of the study, the voluntary nature of participation in the study, and the right to withdraw consent at any time. After giving consent to the study, participants were asked to provide demographic information and respond to a battery of self-report measures. No incentives were offered for participation. Data were collected from July 16, 2019 to January 16,

2020. On average, participants who reached the end of the survey took about 16.9 minutes to complete the survey (*SD* = 8.0 minutes).

Statistical Analysis

A partially latent structural regression (SR) model was used to test the relationships among possible contributing factors to PVGU. In the structural component of the model, parents', siblings', and friends' video game use frequency, age of initiation of video game use, the Gaming Fallacies factor, the Locus of Control factor, and the participants' Video Game Use factor (VGU) were tested as predictors of PVGU. In the measurement component of the model, Locus of Control, Gaming Fallacies, VGU, and PVGU were latent variables. Locus of control was defined by the subscales Internal, Chance, and Powerful Others. Powerful Others, which has higher reliability than Internal or Chance, was used to set the metric. Gaming Fallacies was defined by the subscales Illusion of Control and Predictive Control. Illusion of Control, which has higher reliability than Predictive Control, was used to set the metric. Video Game Use was defined by video game use frequency, video game use quantity, and amount of money spent on video games. Video game use frequency, for which participants are more likely to report accurate numbers, was used to set the metric. PVGU was defined by the YIAS adapted for video games and the PVP scale. The YIAS, which has higher reliability than the PVGU, was used to set the metric. See Figure 1 for a model of the hypothesized relationships that were tested.

An SR model consists of two components: a confirmatory factor analytic (CFA) model, also called the measurement model, and a path model, also called the structural model (Kline, 2015). Because this type of model contains both the measurement and the structural components, it can be used to explore relationships among observed variables as well as the factors underlying those variables. When at least one variable in the structural part of the model is only measured using one variable, the model is said to be a partially latent SR model.

The model must first be identified, or have a unique mathematical solution, before it can be analyzed (Kline, 2015). A two-step rule can be used to ensure identification of the entire model. First, the measurement model must have at least two measured variables for every factor, and the metric must be set for every factor. Second, the structural model must be recursive. In a recursive model, all causal effects are unidirectional, and none of the disturbances (errors) are correlated. If the model meets both of these rules, the model is identified and can be analyzed. The model proposed in this study meets these requirements and is therefore identified.

Compared to testing both measurement and structural components of the SR model simultaneously, it is easier to find the source of poor model fit with two-step modeling (Kline, 2015). In two-step modeling, the CFA component of the SR model is first tested for goodness of fit. If the hypothesized measurement model does not fit the data well, it is respecified to improve model fit. After a well-fitting CFA model is identified, the fit of the full SR model with the structural components superimposed on the best-fitting CFA model is tested.

The analysis was conducted using EQS Version 6.1 with full information maximum likelihood (FIML) estimation. Instead of the traditional approach to handling missing data in SEM, which involves deleting all cases with any missing information, FIML allows all available data to be used, even if some data for a case may be missing.

The following indices were used to assess model fit: model chi-square ($\chi 2$), Root Mean Square Error of Approximation (RMSEA), Comparative Fit Index (CFI), and Standardized Root Mean Square Residual (SRMR). Good fit is indicated by a nonsignificant $\chi 2$, RMSEA $< .05$ with upper limit of the 90% CI $< .1$, CFI $> .9$, SRMR $< .1$, and absolute values of standardized residuals $< .1$. Lagrange Multiplier and Wald tests were evaluated to identify potential changes to the model that might improve fit. The Lagrange Multiplier test assesses whether the model can be significantly improved by adding parameters. The Wald test assesses whether parameters can be deleted without significantly reducing model fit.

CHAPTER THREE

RESULTS

Table 1 shows the correlations, means, and standard deviations of all variables. The measurement model fit the data well: χ^2 (29) = 125.540, $p < .05$; RMSEA = 0.035 (90% CI [.029, .042]); CFI = 0.979; SRMR = .021. The absolute value of only one of the residuals was greater than 0.1. While the model chi square is significant, model chi square is sensitive to sample size such that as the sample size becomes larger, the chi square also becomes larger (Kline, 2015). Therefore, a large sample size such as ours is expected to produce a significant model chi square. As the measurement model did not require re-specification, the fit of the full model was tested; results of model testing are shown in Figure 1. The initial model fit the data well: χ^2 (69) = 494.124, $p < .05$; RMSEA = 0.048 (90% CI [.044, .052]); CFI = 0.916; SRMR = .044. However, the absolute values of two of the residuals were greater than 0.1 and results of the Lagrange multiplier test suggested adding several paths that were strongly consistent with theory, research, and logic. Therefore, the following changes were made to the model, one step at a time:

1. A path from friends' frequency of video game use to VGU was added.
2. A path from gaming fallacies to VGU was added.
3. A path from parents' frequency of video game use to VGU was added.
4. The path from age of initiation to VGU was deleted.
5. The path from parents' frequency of video game use to age of initiation was deleted.
6. The path from age of initiation to PVGU was deleted.

The final full model fit the data well, and its fit was superior to the fit of the originally proposed model: χ^2 (69) = 278.846, $p < .05$; RMSEA = 0.034 (90% CI [.030, .038]); CFI = 0.959; SRMR = .027. Absolute values of all standardized residuals were less than 0.1.

There was a significant positive relationship between parents' video game use frequency and siblings' video game use frequency, such that for every one-day increase in parents' video game use frequency, participants reported an additional one-third day of their sibling's video game use frequency ($b = 0.286$, $p < 0.05$). In addition, there was a significant positive relationship between parents' video game use frequency and VGU, such that for every one-day increase in parents' video game use frequency, participants reported an additional 0.05-point increase in their video game use ($b = 0.053$, $p < 0.05$). However, parents' video game use frequency was not significantly related to participants' PVGU ($p > 0.05$).

There was a significant negative relationship between siblings' video game use frequency and participants' age of initiation of video game use, such that for every one-day increase in siblings' video game use frequency, participants' reported age of initiation of regular video game use was 3.3 months earlier ($b = -0.271$, $p < 0.05$). However, siblings' video game use frequency was not significantly related to participants' PVGU ($p > 0.05$).

There was a significant negative relationship between peer video game use frequency and age of initiation, such that for every one-day increase in peer video game use frequency, participants' reported age of initiation of regular video game use was 3.4 months earlier ($b = -0.287$, $p < 0.05$). In addition, there was a significant positive relationship between peer video game use frequency and VGU, such that for every one-day increase in peer video game use frequency, participants reported an additional 0.259-point increase in their own video game use ($b = 0.259$, $p < 0.05$). Contrary to our hypothesis, there was a significant negative relationship between peer video game use frequency and participants' PVGU, such that for every one-day increase in peer video game frequency, participants' PVGU decreased by one-half point ($b = -0.529$, $p < 0.05$).

Contrary to our hypothesis, the path from age of initiation to VGU, and the path from age of initiation to participants' PVGU, did not fit well with the data and were deleted. However, as hypothesized, there was a significant positive relationship between Gaming Fallacies and PVGU, such that for every one-point increase in Gaming Fallacies, PVGU increased by 1.5 points ($b = 1.482$, $p < 0.05$). The relationship between Locus of Control and PVGU was also significantly positive and in line with our hypothesis, such that for every one-point increase in Llocus of Control, PVGU increased by 1.2 points ($b = 1.161$, $p < 0.05$). Finally, there was a significant positive relationship between the VGU and PVGU, such that for every one-point increase in VGU, PVGU increased by 3.9 points ($b = 3.877$, $p < 0.05$). This was also consistent with our hypothesis.

Parents' video game use frequency explained 5.3% of the variance in siblings' video game use frequency. Siblings' and peers' video game use frequency together explained 2.2% of the variance in age of initiation. Parents' video game use frequency, peers' video game use frequency, and Gaming Fallacies together explained 14.9 % of VGU. Parents', siblings', and peers' video game use frequency, Locus of Control, Gaming Fallacies, and VGU together explained 30.5 % of the variance in participants' PVGU.

In terms of the measurement portion of the final model, all measured variables loaded significantly onto their corresponding factors, *p*s < .05. The Internal subscale of the BLCS was strongly and negatively associated with the Locus of Control factor (λ = -0.637), while the Chance and Powerful Others subscales were strongly and positively associated with the Locus of Control factor (λs = 0.716 and 0.717, respectively). The Locus of Control factor explained approximately 40.577%, 51.266%, and 51.409% of the variance in the Internal, Chance, and Powerful Others subscales of the BLCS, respectively.

The Illusion of Control and Predictive Control subscales of the GRCS were strongly and positively associated with the Gaming Fallacies factor, (λ = 0.694 and 0.559, respectively). The Gaming Fallacies factor explained approximately 48.164% and 31.248% of the variance in the Illusion of Control and Predictive Control subscales of the GRCS, respectively.

Participants' video game use frequency and participants' video game use quantity were strongly and positively associated with the Video Game Use factor (λ = 0.729 and 0.716, respectively), but amount of money spent on video games was not strongly associated with this factor (although it was statistically significant; λ = 0.183). The Video Game Use factor explained approximately 53.144% and 51.266% of the variance in participants' video game use frequency and participants' video game use quantity, respectively.

The YIAS and PVP scales were both strongly and positively associated with PVGU (λ = 0.931 and 0.796, respectively). PVGU explained approximately 86.676% and 63.362% of the variance in the YIAS scale and PVP scale, respectively.

CHAPTER FOUR

DISCUSSIONS

The purpose of this study was to adapt correlates of gambling disorder to video game use, and test them as predictors of PVGU. The proposed model fit the data somewhat well, but the fit indices, as well as the results of the Lagrange multiplier test, suggested modifications to the initial model. A total of six paths were modified, and the fit of the final full model was superior to the fit of the original model. As hypothesized, gaming fallacies, locus of control, and participants' video game use all had significant, positive relationships with PVGU. Parents', siblings', and peers' video game use frequency, Locus of Control, Gaming Fallacies, and Video Game Use together explained 30.5% of the variance in participants' PVGU. This is consistent with previous research that examined the relationship between these variables and PVGU independently (Coëffec et al., 2015; Ream et al., 2011), as well as research that examined these variables in the context of problematic gambling (Brevers & Noël, 2013; Moore & Ohtsuka, 1999).

Furthermore, the effect of the combination of predictors was large, suggesting a clinically significant relationship. It may be helpful to consider these multiple correlates in combination when approaching prevention, assessment, and treatment of PVGU. For example, prevention efforts may focus on providing the general public with information on gaming fallacies and other cognitions related to video games, Clinicians who notice high levels of external locus of control, greater endorsement of gaming fallacies, and increased video game use in their clients may also consider assessing for PVGU. In turn, clinicians who are treating those with PVGU may also consider assessing client's locus of control and gaming fallacies. If client endorses gaming fallacies and external locus of control, clinicians may encourage examination of dysfunctional or erroneous beliefs regarding video games, not unlike challenging cognitive distortions in cognitive behavioral therapy. PVGU by definition is associated with various negative consequences, as video game use becomes out of control and occurs despite negative consequences in various areas of functioning. Therefore, possible treatment methods to reduce PVGU levels deserve increasing attention of researchers and clinicians.

While not an exact match for treatment of PVGU, researchers have already begun studying the effectiveness of a CBT approach to addressing internet addiction. Young (2013) developed Cognitive-Behavioral Therapy for Internet Addiction (CBT-IA), which includes behavior therapy to achieve abstinence from problematic applications, cognitive restructuring to address maladaptive cognitions specific to internet use (e.g., “I am worthless offline, but in the online world I am someone”), and Harm Reduction Therapy for relapse prevention. Young found that following twelve sessions of CBT-IA, participants reported increased ability to control their internet use, decreased preoccupation with using the internet, and improved relationships (ps < 0.01). Young also found that participants were able to maintain a structured internet use at six months after treatment.

Similarly, Santos et al. (2016) examined the effects of CBT and pharmacotherapy on participants with internet addiction and anxiety disorders, as indicated by high scores on an internet addiction scale and diagnosed with anxiety disorders by a psychiatrist. The CBT administered to these participants included psychoeducation about anxiety and internet use, cognitive distortions that were specific to internet use (e.g., “I have to answer my friends immediately, otherwise they will not forgive me"), behavioral modification including time management and social skills, and reinforcement of recovery and relapse prevention. After ten sessions of psychotherapy outlined above, participants scored significantly lower on scales measuring internet addiction, depression, anxiety, and clinical global impressions (*t*s < 0.001) compared to their baseline scores prior to treatment. Similarly, treatment for PVGU may include comparable elements, including psychoeducation about PVGU, cognitive restructuring to address gaming fallacies, behavioral modification, and reinforcement of recovery and relapse prevention.

In fact, Huanhuan and Su (2013) examined the effects of CBT for treatment of online PVGU in adolescents. The treatment group received twelve group sessions over six weeks, which focused on disputing cognitive distortions about online PVGU and replacing them with rational beliefs. Cognitive distortions examined in this study included all-or-nothing thinking, online comfort (i.e., belief that online spaces are more comfortable, safe, and real than offline spaces), rumination, and short-term thinking. The control group completed interviews regarding their online video game use as well as basic counseling. There was a significant decrease in the endorsement of some of the cognitive distortions by the treatment group after the intervention, including all-or-nothing thinking and online comfort (*p*s < 0.05). However, the decrease in PVGU post-intervention was not significantly different between the treatment group and the control group; in both groups, participants reported lower PVGU post-treatment. The fact that basic counseling did not address cognitive distortions specific to video games in Huanhuan and Su (2013) may suggest that such distortions warrant specialized attention, especially if these distortions are inherently unhelpful or problematic by themselves.

Overall, recent literature appears to support CBT as an effective treatment modality to address symptoms and contributors of PVGU, and results of the current study suggest that particular attention to cognitions associated with PVGU, including high external locus of control and gaming fallacies, may be relevant to treatment of PVGU.

Parents' video game use frequency, while positively and significantly associated with siblings' video game use frequency and participants' video game use, was not significantly associated with PVGU. Siblings' video game use frequency, while significantly associated with younger age of initiation, was not significantly associated with PVGU either. Studies on problematic gambling (Canale et al., 2017; Vachon et al., 2004) and screen-viewing time that includes TV use, video game use, and internet use (Jago et al., 2012) suggest a relationship between family members' behavior and the participants' problematic behavior. However, there does not seem to be such a relationship between family member's video game use and the participants' PVGU. It could be that the mechanism underlying the relationship between family members' behavior and gambling functions differently in the context of video games.

Specifically, one potential mechanism that could be at play is parents' modeling of good gaming behavior and structural limitations to prevent video game use from becoming out of control. The Entertainment Software Association reports that parents assume some level of control over their child's video game use, including being present when the child obtains video games (95% of parents), requiring permission for new game purchases (86% of parents), and limiting amount of time spent on playing video games (48% of parents). Parents' control over their child's video game use, or video game use in childhood, was not examined in the current study. However, it could be that parents who have firsthand experience with video games may be better attuned to more effective ways of exerting and maintaining control over their child's video game use, and be more motivated to do so. Subsequently, an adult whose video game use was regulated as such in childhood may be more likely to engage in healthy video game use, compared to someone whose video game use was not regulated or poorly regulated. If this modeling and limit-setting behavior serves as a protective factor against PVGU, it could be acting as a moderator for the relationship between parents' video game use and PVGU. For example, the relationship between parents' video game use and PVGU may be positive for people whose parents did not model healthy video game use, but may be negative for people whose parents did model healthy video game use. In fact, results of the current study suggest that family members' video game use does have a relationship with non-problematic video game use, such as increased video game use without the problematic aspects of PVGU. Predictors of non-problematic video game use may not always be predictors of PVGU.

Greater peer video game use frequency was significantly associated with younger age of initiation and increased participants' video game use, consistent with the hypotheses. However, while the relationship between peer video game use frequency and PVGU was significant, the direction was contrary to our hypothesis, such that greater peer video game frequency was associated with less PVGU. Cummings and Vandewater (2007) found that the more time adolescents played video games with friends on the weekends, the more time they spent with friends engaging in other activities as well. The current study does not directly measure whether the participants play video games with others. However, it could be that the participants with close friends who play video games frequently spend time with these friends on a variety of activities, not just video games, which may reduce opportunities for problematic use of video games to develop. Furthermore, participants whose close friends play video games frequently may be motivated to manage their video game use in order to play with their friends. For example, one might arrange a specific time with their friends to play together, or wait on using a limited game-related resource in order to share with their friends. Such behaviors may contribute to increased control over video game use and serve as a protective factor against PVGU.

Another explanation for the current results regarding peer video game use could be a normalization effect of PVGU within peer groups. Video game players may be less likely to perceive and report their video game use as problematic, if all of their peers engage in similar video game use. Alternatively, if a video game player has one friend whose PVGU is significantly more severe, the player might come to the conclusion that their own behavior is unproblematic, even if it meets the criteria for a gaming disorder. Future studies exploring the effect of peer video game use on PVGU may consider both the motivation to control own video game use as well as the potential normalization of own video game use through peer video game use.

Age of initiation was not significantly associated with PVGU, contrary to our hypothesis. Younger age of initiation of a behavior is typically associated with later problematic behavior, in the context of substances (Grant & Dawson, 1998) as well as gambling (Slutske et al., 2014). Furthermore, a 2017 study found that younger age of initiation was related to PVGU directly, indirectly through self-esteem, and indirectly through gaming-contingent self-worth (Beard et al., 2017). While it is unclear why the current study does not suggest a relationship between age of initiation and PVGU, it could be that adding self-esteem and gaming-contingent self-worth to the model may help clarify the role of age of initiation on PVGU. Another point of consideration for these differing results may have to do with the demographic differences of the participants. The participants in Beard et al.'s study were recruited through Amazon Mechanical Turk, and were paid between $0.30 to $0.75 for participation. The current study provided no compensation for participation. Furthermore, inclusion criteria for Beard et al.'s study included that participants identified themselves as MMORPG players. The current study included participants who identified themselves as video game players, regardless of the genre of video games played. While there is no research to date examining whether use of MMORPGs affects the relationship between age of initiation and PVGU in some way, the possible role of MMORPG use in the relationship between age of initiation and PVGU warrants future attention.

The measurement portion of the model also allowed examination of the factor loadings of measured variables. As expected, the subscales of the Gambling Related Cognition Scale and the subscales of the Brief Locus of Control Scale were strongly associated with their respective factors. The Young's Internet Addiction Scale, adapted for video game use, and the Problem Videogame Playing Scale, were both strongly and positively associated with PVGU, suggesting they measure the same construct. This is consistent with a previous study that used these two scales for the PVGU factor (Lee et al., 2018).

Participants' video game use frequency and participants' video game use quantity loaded strongly and positively on the Video Game Use factor, but amount of money spent on video games, while statistically significant, was not strongly associated with this factor. The fact that this variable did not load strongly on Video Game Use, coupled with the fact that over half of the participants reported not spending any money on video games in a typical week (57.6%), suggests that amount of money spent on video games may be an aspect of video game-related behavior that is in some way significantly different from frequency and quantity of video game use. For example, amount of money spent on video games might be better conceptualized as a consequence of video game use, rather than a descriptor of video game use. That is, spending money on video game need not occur for video game use to occur, especially given the variety and quantity of free video games currently available. However, as video game players increase their video game use, they may be compelled to make variety of game-related purchases to upgrade their hardware, obtain a number of paid video game titles, or make in-game purchases. Conversely, video game use frequency and video game use quantity are more likely to be contributing to measuring a single construct related to amount of video game use.

It could also be that increased money spending behavior, such as high amounts or frequency of video-game related purchases, is more descriptive of PVGU than non-problematic video game use. Money spending behavior is not currently an explicit criterion for gaming disorder in the ICD-11 or for internet gaming disorder in the DSM-5, but both include criteria related to sacrificing other aspects of life, such as giving up other activities due to gaming (DSM-5; American Psychiatric Association, 2013) or gaming takes precedence over other interests and daily activities (ICD-11; WHO, 2020). If one's money spending behavior becomes excessive or unsustainable for meeting one's various needs and interests outside of video games, such money spending behavior may suggest PVGU. While this idea was not examined in the current study, future studies may explore money spending behavior as a descriptor or an indicator for PVGU. Lastly, it could be that the results related to money spending behavior could have been confounded due to the way data were collected. Participants were asked to report the amount of money spent in U.S. dollars, and only about half of the participants lived in the U.S. Participants might have not converted the amount correctly, which would interfere with obtaining accurate data. Even if the currency conversions were calculated correctly, costs may vary widely across countries, and therefore what is considered expensive may also be quite different across countries, making it difficult to determine what are problematic levels of spending.

The current study has a number of strengths, including the large international sample and the use of two reliable and valid instruments to measure PVGU. However, a couple of limitations of the study should be taken into consideration when interpreting the results of this study. First, the sample of the study was predominately male (85%) and Caucasian (68%). This makes the results difficult to generalize to non-males and individuals of other racial and ethnic backgrounds. The data were collected via self-report. Participants may have inaccurate perceptions regarding their behavior, or they may be subject to response bias and minimize their video game use and/or PVGU. As the data are cross-sectional, causal relationships among variables of interest cannot be inferred from the results of this study. Some data points, including parents' video game use and siblings' video game use, were collected retrospectively, and therefore may be subject to recall bias. Another limitation is the poor reliability for Problem Videogame Playing scale and the two subscales of the Gambling Related Cognition Scale (GRCS), which may have attenuated any observed relationships with these variables. Problem Videogame Playing scale had a Cronbach's alpha of 0.64. For GRCS, the Illusion of Control subscale had a Cronbach's alpha of 0.51, and the Predictive Control subscale had a Cronbach's alpha of 0.6. Finally, the model may have benefitted from including several variables to further clarify the relationships among the constructs examined in this study. Variables that were not directly measured, but may help explain findings of the current study, have been discussed earlier in this document and are as follows: participants' video game use with their parents, siblings, or peers; parents' modeling of good gaming behavior and control over participants' video game use in childhood; and participants' self-esteem and gaming contingent self-worth.

The current study adds new information to the current understanding of PVGU. The combination of external locus of control, greater endorsement of gaming fallacies, and increased video game use is significantly associated with higher PVGU. Tracking and addressing these variables may help in prevention and treatment of PVGU. As described earlier, further studies are required for greater understanding about PVGU and its contributing factors. Given the demographic characteristics of the sample of the current study, our model should be tested to see if it holds across genders, countries, racial/ethnic groups, and so forth. Studies on the role of peer video game use on PVGU may gather additional information about video game-related behaviors with peers, including additional information about peers such as age group and nature of the relationship with the participants (e.g., friends, roommates, etc.), as well as participants' concurrent use with friends that may elicit motivation to control own video game use or allow for normalization of own video game use. Other potential predictors of PVGU that warrant further studies include modeling behavior from parents, money spending behavior, and the combined effects of age of initiation, self-esteem, and gaming-contingent self-worth.

References

Adachi, P. J. C., & Willoughby, T. (2013). More than just fun and games: The longitudinal relationships between strategic video games, self-reported problem solving skills, and academic grades. *Journal of Youth and Adolescence*, *42*(7), 1041–1052. https://doi.org/10.1007/s10964-013-9913-9

American Psychiatric Association. (2000). Diagnostic and statistical manual of mental disorders (4th ed., text rev.).

American Psychiatric Association. (2013). Diagnostic and statistical manual of mental disorders (5th ed.). https://doi.org/10.1176/appi.books.9780890425596

Beard, C. L., Haas, A. L., Wickham, R. E., & Stavropoulos, V. (2017). Age of initiation and internet gaming disorder: The role of self-esteem. *Cyberpsychology, Behavior, and Social Networking*, *20*(6), 397–401. https://doi.org/10.1089/cyber.2017.0011

Brevers, D., & Noël, X. (2013). Pathological gambling and the loss of willpower: A neurocognitive perspective. *Socioaffective Neuroscience & Psychology*, *3*(1), https://doi.org/10.3402/snp.v3i0.21592

Brookhaven National Laboratory. (2008). *The first video game?* Retrieved from https://www.bnl.gov/about/history/firstvideo.php

Browne, B. A., & Brown, D. J. (1994). Predictors of lottery gambling among American college students. In *The Journal of Social Psychology*, *134*(3), 339–347. https://doi.org/10.1080/00224545.1994.9711738

Butnik, S. M. (2005). Neurofeedback in adolescents and adults with attention deficit hyperactivity disorder. *Journal of Clinical Psychology*, *61*(5), 621–625. https://doi.org/10.1002/jclp.20124

Calvert, S. L., Appelbaum, M., Dodge, K. A., Graham, S., Hall, G. C. N., Hamby, S., Fasig-caldwell, L. G., Galloway, D. P., Hedges, L. V, & Sandra, L. (2017). The American Psychological Association Task Force Assessment of Violent Video Games: Science in the Service of Public Interest. *American Psychologist, 72*(2), 126–143.

Canale, N., Vieno, A., Griffiths, M. D., Siciliano, V., Cutilli, A., & Molinaro, S. (2017). ‘“ I am becoming more and more like my eldest brother !”’: The relationship between older siblings, adolescent gambling severity, and the attenuating role of parents in a large-scale nationally representative. *Journal of Gambling Studies*, *33*(2), 425–435. https://doi.org/10.1007/s10899-016-9643-5

Chan, P. A, & Rabinowitz, T. (2006). A cross-sectional analysis of video games and attention deficit hyperactivity disorder symptoms in adolescents. *Annals of General Psychiatry*, *5*(16). https://doi.org/10.1186/1744-859X-5-16

Coëffec, A., Romo, L., Cheze, N., Riazuelo, H., Plantey, S., Kotbagi, G., & Kern, L. (2015). Early substance consumption and problematic use of video games in adolescence. *Frontiers in Psychology*, *6*, 1–8. https://doi.org/10.3389/fpsyg.2015.00501

Cummings, H. M., & Vandewater, E. A. (2007). Relation of adolescent video game play to time spent in other activities. *Archives of Pediatrics and Adolescent Medicine*, *161*(7), 684–689. https://doi.org/10.1001/archpedi.161.7.684

Di Chiara, G. (1998). A motivational learning hypothesis of the role of mesolimbic dopamine in compulsive drug use. *Journal of Psychopharmacology*, *12*(1), 54–67. https://doi.org/10.1177/026988119801200108

Entertainment Software Association. (2017). Essential facts 2017. In *ESA Report 2017* (Vol. 2017).

Entertainment Software Association. (2020). 2020 Essential facts about the video game industry. *Cision*, 1–2. https://www.prnewswire.com/news-releases/new-survey-2020-essential-facts-about-the-video-game-industry-301093972.html

Ferguson, C. J., Coulson, M., & Barnett, J. (2011). A meta-analysis of pathological gaming prevalence and comorbidity with mental health, academic and social problems. *Journal of Psychiatric Research*, *45*(12), 1573–1578. https://doi.org/10.1016/j.jpsychires.2011.09.005

Fortune, E. E., Mackillop, J., Miller, J. D., Campbell, W. K., Clifton, A. D., & Goodie, A. S. (2013). Social density of gambling and its association with gambling problems : An initial investigation. *Journal of Gambling Studies*, *29*(2), 329–342. https://doi.org/10.1007/s10899-012-9303-3

Gentile, D. A., Choo, H., Liau, A., Sim, T., Li, D., Fung, D., & Khoo, A. (2011). Pathological video game use among youths: A two-year longitudinal study. *Pediatrics*, *127*(2), e319–e329. https://doi.org/10.1542/peds.2010-1353

Goodman, A. (1990). Addiction: Definition and implications. *British Journal of Addiction*, *85*(11), 1403–1408.

Grant, B. F., & Dawson, D. A. (1998). Age of onset of drug use and its association with DSM-IV drug abuse and dependence: Results from the national longitudinal alcohol epidemiologic survey. *Journal of Substance Abuse*, *10*(2), 163–173. https://doi.org/10.1016/S0899-3289(99)80131-X

Griffiths, M. D. (2010). The role of parents in the development of gambling behaviour in adolescents. *Education and Health, 28*(3), 51–54.

Griffiths, M. D., & Auer, M. (2013). The irrelevancy of game-type in the acquisition, development, and maintenance of problem gambling. *Frontiers in Psychology*, *3*, 2012–2014. https://doi.org/10.3389/fpsyg.2012.00621

Grüsser, S. M. M., Thalemann, R., & Griffiths, M. D. D. (2007). Excessive computer game playing: Evidence for addiction and aggression? *CyberPsychology & Behavior*, *10*(2), 290–292. https://doi.org/10.1089/cpb.2006.9956

Gupta, R., & Derevensky, J. (1997). Familial and social influences on juvenile gambling behavior. *Journal of Gambling Studies*, *13*(3), 179–192.

Hardoon, K. K., Gupta, R., & Derevensky, J. L. (2004). Psychosocial variables associated with adolescent gambling. *Psychology of Addictive Behaviors: Journal of the Society of Psychologists in Addictive Behaviors*, *18*(2), 170–179. https://doi.org/10.1037/0893-164X.18.2.170

Hingson, R. W., Heeren, T., & Winter, M. R. (2006). Age at drinking onset and alcohol dependence. *Archives of Pediatrics & Adolescent Medicine*, *160*(7), 739. https://doi.org/10.1001/archpedi.160.7.739

Hoeft, F., Watson, C. L., Kesler, S. R., Bettinger, K. E., & Reiss, A. L. (2008). Gender differences in the mesocorticolimbic system during computer game-play. *Journal of Psychiatric Research*, *42*(4), 253–258. https://doi.org/10.1016/j.jpsychires.2007.11.010

Huanhuan, L., & Su, W. (2013). The role of cognitive distortion in online game addiction among Chinese adolescents. *Children and Youth Services Review*, *35*(9), 1468–1475. https://doi.org/10.1016/j.childyouth.2013.05.021

Istvan, J., & Matarazzo, J. (1984). *Tobacco, alcohol, and caffine use - A review of their interrelationships*, *95*(2), 301–326.

Jago, R., Stamatakis, E., Gama, A., Carvalhal, I. M., Nogueira, H., Rosado, V., & Padez, C. (2012). Parent and child screen-viewing time and home media environment. *American Journal of Preventive Medicine*, *43*(2), 150–158. https://doi.org/10.1016/j.amepre.2012.04.012

Karim, R., & Chaudhri, P. (2012). Behavioral addictions: An overview. *Journal of Psychoactive Drugs*, *44*(1), 5–17. https://doi.org/10.1080/02791072.2012.662859

Kessler, R. C., Hwang, I., Labrie, R., Petukhova, M., Sampson, N. A., Winters, K. C., & Shaffer, H. J. (2008). The prevalence and correlates of DSM-IV Pathological Gambling in the National Comorbidity Survey Replication. *Psychological Medicine*, *38*(9), 1351–1360. https://doi.org/10.1017/S0033291708002900.The

King, D. L., Ejova, A., & Delfabbro, P. H. (2012). Illusory control, gambling, and video gaming: An investigation of regular gamblers and video game players. *Journal of Gambling Studies*, *28*(3), 421–435. https://doi.org/10.1007/s10899-011-9271-z

King, D. L., Gainsbury, S. M., Delfabbro, P. H., Hing, N., & Abarbanel, B. (2015). Distinguishing between gaming and gambling activities in addiction research. *Journal of Behavioral Addictions*, *4*(4), 215–220. https://doi.org/10.1556/2006.4.2015.045

Klepek, Patrick (2017). Nintendo's mobile 'Fire Emblem' is a 'Gacha' game, here's what that means. Waypoint. Retrieved from https://waypoint.vice.com/en_us/article/wnn834/

nintendos-mobile-fire-emblem-is-a-gacha-game-heres-what-that-means

Kline, R. B. (2015). *Principles and practice of structural equation modeling* (4th ed.). Guilford Press.

Ko, C.-H., Yen, J.-Y., Yen, C.-F., Lin, H.-C., & Yang, M.-J. (2007). Factors predictive for incidence and remission of internet addiction in young adolescents: A prospective study. *Cyberpsychology & Behavior: The Impact of the Internet, Multimedia and Virtual Reality on Behavior and Society*, *10*(4), 545–551. https://doi.org/10.1089/cpb.2007.9992

Lee, H., Tran, D. D., & Morrell, H. E. R. (2018). Smoking, ADHD, and problematic video game use: A structural modeling approach. *Cyberpsychology, Behavior, and Social Networking* , *21*(5), 281–286. https://doi.org/10.1089/cyber.2017.0429.

Leonard, C. A., & Williams, R. J. (2016). The relationship between gambling fallacies and problem gambling. *Psychology of Addictive Behaviors*, *30*(6), 694–704. https://doi.org/10.1037/adb0000189

Leonard, C. A., Williams, R. J., & Vokey, J. (2015). Gambling fallacies: What are they and how are they best measured? *Journal of Addiction Research & Therapy*, *6*(4), 1–9. https://doi.org/10.4172/2155-6105.1000256

Levenson, H. (1973). Multidimensional locus of control in psychiatric patients. *Journal of Consulting and Clinical Psychology*, *41*(3), 397–404. https://doi.org/10.1037/h0035357

Lumpkin, J. R. (1985). Validity of a brief locus of control scale for survey research. *Psychological Reports*, *57*(2), 655–659. https://doi.org/10.2466/pr0.1985.57.2.655

Lumpkin, J. R. (1988). Eestablishing the validity of an abbreviated locus of control scale: Is a brief Levenson's scale any better? *Psychological Reports, 63*(2), 519–523. https://doi.org/10.2466/pr0.1988.63.2.519

Lynch, W. J., Maciejewski, P. K., & Potenza, M. N. (2004). Psychiatric correlates of gambling in adolescents and young adults grouped by age at gambling onset. *Archives of General Psychiatry*, *61*(11), 1116-1122. https://doi.org/10.1001/archpsyc.61.11.1116

Maillot, P., Perrot, A., & Hartley, A. (2012). Effects of interactive physical-activity video-game training on physical and cognitive function in older adults. *Psychology and Aging*, *27*(3), 589–600. https://doi.org/10.1037/a0026268

Maras, D., Flament, M. F., Murray, M., Buchholz, A., Henderson, K. A., Obeid, N., & Goldfield, G. S. (2015). Screen time is associated with depression and anxiety in Canadian youth. *Preventive Medicine*, *73*, 133–138. https://doi.org/10.1016/j.ypmed.2015.01.029

Mcbride, J., & Derevensky, J. (2016). Gambling and video game playing among youth. *Journal of Gambling Issues*, *34*, 156–179.

Melchior, M., Chollet, A., Fombonne, E., Surkan, P. J., & Dray-Spira, R. (2014). Internet and video game use in relation to overweight in young adults. *American Journal of Health Promotion*, *28*(5), 321–324. https://doi.org/10.4278/ajhp.121023-ARB-

515

Moore, S. M., & Ohtsuka, K. (1999). Beliefs about control over gambling among young people, and their relation to problem gambling. *Psychology of Addictive Behaviors*, *13*(4), 339–347. https://doi.org/10.1037/0893-164X.13.4.339

Mordor Intelligence. (2021). Gaming market - growth, trends, COVID-19 impact, and forecasts (2021 - 2026). Retrieved from https://www.mordorintelligence.com/industry-reports/global-games-market

Page, Z. E., Barrington, S., Edwards, J., & Barnett, L. M. (2017). Do active video games benefit the motor skill development of non-typically developing children and adolescents: A systematic review. *Journal of Science and Medicine in Sport*, *20*(12), 1087–1100. https://doi.org/10.1016/j.jsams.2017.05.001

Paik, S. H., Cho, H., Chun, J. W., Jeong, J. E., & Kim, D. J. (2017). Gaming device usage patterns predict internet gaming disorder: Comparison across different gaming device usage patterns. *International Journal of Environmental Research and Public Health*, *14*(12), 1512. https://doi.org/10.3390/ijerph14121512

Porter, G., Starcevic, V., Berle, D., & Fenech, P. (2010). Recognizing problem video game use. *The Australian and New Zealand Journal of Psychiatry*, *44*(2), 120–128. https://doi.org/10.3109/00048670903279812

Raylu, N., & Oei, T. P. S. (2004). The gambling related cognitions scale (GRCS): Development, confirmatory factor validation, and psychometric properties. *Addiction*, *99*(6), 757–769. https://doi.org/10.1111/j.1360-0443.2004.00753.x

Ream, G. L., Elliott, L. C., & Dunlap, E. (2011). Playing video games while using or feeling the effects of substances: Associations with substance use problems. *International Journal of Environmental Research and Public Health*, *8*, 3979–3998. https://doi.org/10.3390/ijerph8103979

Rotter, J. B. (1966). Generalized expectancies for internal versus external control of reinforcement. *Psychological Monographs: General and Applied*, *80*(1), 1–28. https://doi.org/10.1037/h0092976

Santos, V. A., Freire, R., Zugliani, M., Cirillo, P., Santos, H. H., Nardi, A. E., & King, A. L. (2016). Treatment of internet addiction with anxiety disorders: Treatment protocol and preliminary before-after results involving pharmacotherapy and modified cognitive behavioral therapy. *JMIR research protocols*, *5*(1), e46. https://doi.org/10.2196/resprot.5278

Sapp, S. G., & Harrod, W. J. (1993). Reliability and validity of a brief version of Levenson'S locus of control scale. *Psychological Reports*, *72*(2), 539–550. https://doi.org/10.2466/pr0.1993.72.2.539

Schmidt, M. E., & Vandewater, E. A. (2008). Media and attention, cognition, and school achievement. *Future of Children*, *18*(1), 63–85. https://doi.org/10.1353/foc.0.0004

Slutske, W. S., Deutsch, A. R., Richmond-Rakerd, L. S., Chernyavskiy, P., Statham, D. J., & Martin, N. G. (2014). Test of a potential causal influence of earlier age of gambling initiation on gambling involvement and disorder: A multilevel discordant twin design. *Psychology of Addictive Behaviors*, *28*(4), 1177–1189. https://doi.org/10.1037/a0035356

Stroud, M. J., & Whitbourne, S. K. (2015). Casual video games as training tools for attentional processes in everyday life. *Cyberpsychology, Behavior, and Social Networking*, *18*(11), 654–660. https://doi.org/10.1089/cyber.2015.0316

Tejeiro Salguero, R. A., & Bersabé Morán, R. M. (2002). Measuring problem video game playing in adolescents. *Addiction*, *97*(12), 1601–1606. https://doi.org/10.1046/j.1360-0443.2002.00218.x

Vachon, J., Vitaro, F., Wanner, B., & Tremblay, R. E. (2004). Adolescent gambling: Relationships with parent gambling and parenting practices. *Psychology of Addictive Behaviors: Journal of the Society of Psychologists in Addictive Behaviors*, *18*(4), 398–401. https://doi.org/10.1037/0893-164X.18.4.398

Van Rooij, A. J., Kuss, D. J., Griffiths, M. D., Shorter, G. W., Schoenmakers, M. T., & Van de Mheen, D. (2014). The (co-)occurrence of problematic video gaming, substance use, and psychosocial problems in adolescents. *Journal of Behavioral Addictions*, *3*(3), 157–165. https://doi.org/10.1556/JBA.3.2014.013

Walther, B., Morgenstern, M., & Hanewinkel, R. (2012). Co-occurrence of addictive behaviours: Personality factors related to substance Use, gambling and computer gaming. *European Addiction Research*, *18*(4), 167–174. https://doi.org/10.1159/000335662

Wang, C. W., Chan, C. L. W., Mak, K. K., Ho, S. Y., Wong, P. W. C., & Ho, R. T. H. (2014). Prevalence and correlates of video and internet gaming addiction among Hong Kong adolescents: A pilot study. *Scientific World Journal*, *2014*. https://doi.org/10.1155/2014/874648

Wenzel, H. G., Bakken, I. J., Johansson, A., Götestam, K. G., & Øren, A. (2009). Excessive computer game playing among Norwegian adults: Self-reported consequences of playing and association with mental health problems. *Psychological Reports*, *105*(3), 1237–1247. https://doi.org/10.2466/PR0.105.F.1237-1247

Widyanto, L., & McMurran, M. (2004). The psychometric properties of the internet addiction test. *Cyberpsychology & Behavior: The Impact of the Internet, Multimedia, and Virtual Reality on Behavior and Society*, *7*(4), 443–450. https://doi.org/10.1089/cpb.2004.7.443

World Health Organization (2020). *International statistical classification of diseases and related health problems* (11th ed.). https://icd.who.int/

Wu, J. Y. W., Ko, H.-C., Wong, T.-Y., Wu, L.-A., & Oei, T. P. (2016). Positive outcome expectancy mediates the relationship between peer influence and internet gaming addiction among adolescents in Taiwan. *Cyberpsychology, Behavior, and Social Networking*, *19*(1), 49–55. https://doi.org/10.1089/cyber.2015.0345

Ybarra, M. L., Huesmann, L. R., Korchmaros, J. D., & Reisner, S. L. (2014). Cross-sectional associations between violent video and computer game playing and weapon carrying in a national cohort of children. *Aggressive Behavior*, *40*(4), 345–358. https://doi.org/10.1002/ab.21526

Young, K. S. (1998). Internet addiction: The emergence of a new clinical disorder. *CyberPsychology & Behavior*, *1*(3), 237–244. https://doi.org/10.1089/cpb.1998.1.237

Young, K. S. (2013). Treatment outcomes using CBT-IA with internet-addicted patients. *Journal of Behavioral Addictions*, *2*(4), 209–215. https://doi.org/10.1556/JBA.2.2013.4.3

Zhou, K., Tang, H., Sun, Y., Huang, G. H., Rao, L. L., Liang, Z. Y., & Li, S. (2012). Belief in luck or in skill: Which locks people into gambling? *Journal of Gambling Studies*, *28*(3), 379–391. https://doi.org/10.1007/s10899-011-9263-z

Table 1

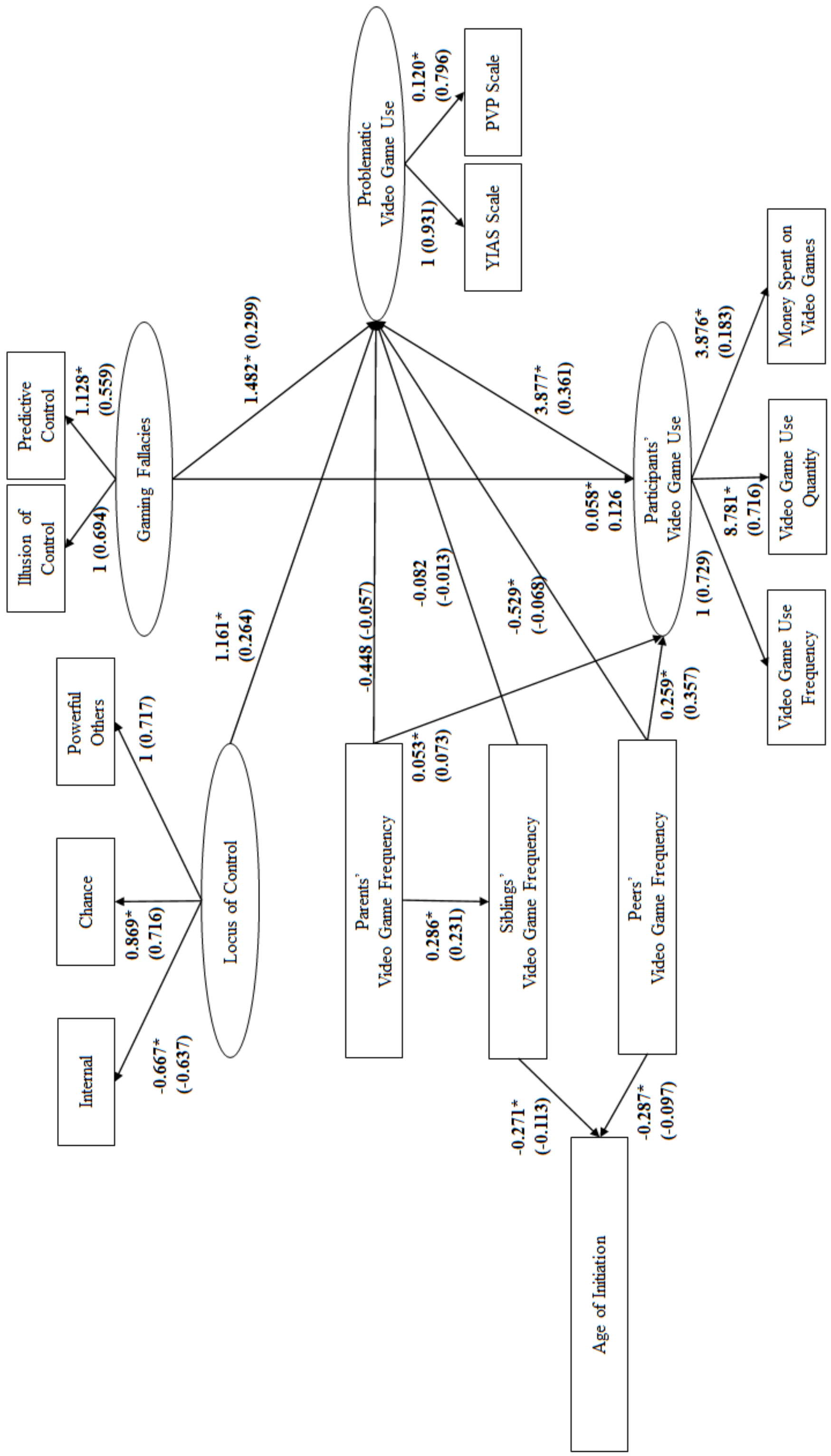
Correlations, Means, and Stand Deviations

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	*M*	*SD*
1. Parents' Video Game Use Frequency	1														2.340	1.705
2. Siblings' Video Game Use Frequency	0.230**	1													4.380	2.110
3. Friends' Video Game Use Frequency	0.110**	0.124**	1												5.450	1.718
4. Age of Initiation	-0.001	-0.112**	-0.108**	1											10.270	5.077
5. Participant's Video Game Use Frequency	0.057	0.102**	0.311**	-0.024	1										5.460	1.714
6. Participants' Video Game Use Quantity	0.095**	0.056*	0.209**	-0.032	0.525**	1									21.635	15.335
7. Participants' Money Spent on Video Games	0.044	-0.034	0.061**	-0.032	0.090**	0.170**	1								6.450	26.417
8. Gaming Fallacies - Illusion of Control	0.049	0.025	0.072**	-0.064**	0.066**	0.111**	0.012	1							10.518	3.906
9. Gaming Fallacies - Predictive Control	0.055	0.059*	0.049*	-0.065**	0.060**	0.049*	0.022	0.388**	1						20.690	5.470
10. Locus of Control - Internal	0.031	0.007	-0.004	-0.013	-0.028	-0.030	0.028	0.007	0.124**	1					16.038	3.194
11. Locus of Control - Chance	0.025	0.054*	0.036	0.007	0.043*	0.062**	-0.026	0.079**	0.023	-0.462**	1				10.110	3.707
12. Locus of Control - Powerful Others	0.011	0.011	0.018	-0.044*	0.032	0.051*	-0.011	0.064**	0.009	-0.453**	0.513**	1			8.652	4.257
13. YIAS, adapted for video game use	0.002	0.012	0.080**	-0.053*	0.241**	0.296**	0.080**	0.227**	0.160**	-0.153**	0.198**	0.216**	1		29.545	14.455
14. Problem Videogame Playing Scale	-0.017	-0.011	0.048*	-0.080**	0.158**	0.215**	0.096**	0.239**	0.207**	-0.119**	0.142**	0.194**	0.742**	1	2.923	2.023

Note. YIAS = Young’s Internet Addiction Scale adapted for video game use.
**p* < .05. ***p* < .01.

Figure 1

Full Structural Regression Model of Problematic Video Game Use



Note. Standardized values are in parentheses. $^*p < 0.05$.

APPENDIX A

Demographic Information Questions

1. What is your age?

2. What is your gender?

    a. Male, cisgender (male assigned sex matches male gender identity)
    b. Male, transgender (female assigned sex and male gender identity)
    c. Female, cisgender (female assigned sex matches female gender identity)
    d. Female, transgender (male assigned sex and female gender identity)
    e. Non-binary (gender identity not exclusively masculine or feminine)
    f. Gender fluid (gender identity flexible or dynamic)
    g. Agender (without a gender identity)

3. What is your marital status?

    a. Single
    b. Dating
    c. Married
    d. Separated
    e. Divorced
    f. Widowed

4. What is your occupation?

    a. Student
    b. Full-time Employment
    c. Part-time Employment
    d. Unemployed

5. What best describes your ethnicity (choose one)?

a. Hispanic or Latino

b. Not Hispanic or Latino

6. What best describes your race (choose one)?

a. American Indian/Alaska Native

b. Asian or Asian American

c. Native Hawaiian or Other Pacific Islander

d. Black or African American

e. White

f. Other (please specify):

g. Mixed Race (please specify):

7. What is your country of residence?

8. What is your highest level of education?

a. Some High School

b. High School Diploma or GED

c. Some College

d. Undergraduate Degree

e. Some Graduate Education

f. Graduate Degree

APPENDIX B

Young's Internet Addiction Scale: Adapted for Video Game Use

Please answer the following questions using this scale:

0-----------------1-----------------2-----------------3-----------------4-----------------5

Not at all Rarely Occasionally Frequently Often Always

1. How often do you find that you play video games longer than you intended?

0-----------------1-----------------2-----------------3-----------------4-----------------5

Not at all Rarely Occasionally Frequently Often Always

2. How often do you neglect household chores to spend more time playing video games?

0-----------------1-----------------2-----------------3-----------------4-----------------5

Not at all Rarely Occasionally Frequently Often Always

3. How often do you prefer the excitement of video games to intimacy with your partner?

0-----------------1-----------------2-----------------3-----------------4---------------

---5

Not at all Rarely Occasionally Frequently Often

Always

4. How often do you form new relationships with fellow video game users?

0-----------------1-----------------2-----------------3-----------------4---------------

---5

Not at all Rarely Occasionally Frequently Often

Always

5. How often do others in your life complain to you about the amount of time you spend playing video games?

0-----------------1-----------------2-----------------3-----------------4---------------

---5

Not at all Rarely Occasionally Frequently Often

Always

6. How often do your grades or school work suffer because of the amount of time you spend playing video games?

0-----------------1-----------------2-----------------3-----------------4---------------

---5

Not at all Rarely Occasionally Frequently Often

Always

7. How often do you play video games before something else that you need to do?

0------------------1------------------2------------------3------------------4-----------------5

Not at all Rarely Occasionally Frequently Often

Always

8. How often does your job performance or productivity suffer because of playing video games?

0------------------1------------------2------------------3------------------4-----------------5

Not at all Rarely Occasionally Frequently Often

Always

9. How often do you become defensive or secretive when anyone asks you about your gaming?

0------------------1------------------2------------------3------------------4-----------------5

Not at all Rarely Occasionally Frequently Often

Always

10. How often do you block out disturbing thoughts about your life with soothing thoughts of video games?

0------------------1------------------2------------------3------------------4---------------
---5

Not at all Rarely Occasionally Frequently Often
Always

11. How often do you find yourself anticipating when you will play video games again?

0------------------1------------------2------------------3------------------4---------------
---5

Not at all Rarely Occasionally Frequently Often
Always

12. How often do you fear that life without video games would be boring, empty, and joyless?

0------------------1------------------2------------------3------------------4---------------
---5

Not at all Rarely Occasionally Frequently Often
Always

13. How often do you snap, yell, or act annoyed if someone bothers you while you are playing video games?

0------------------1------------------2------------------3------------------4-----------------5

Not at all Rarely Occasionally Frequently Often Always

14. How often do you lose sleep due to late-night gaming?

0------------------1------------------2------------------3------------------4-----------------5

Not at all Rarely Occasionally Frequently Often Always

15. How often do you feel preoccupied with video games when not playing, or fantasize about playing a video game?

0------------------1------------------2------------------3------------------4-----------------5

Not at all Rarely Occasionally Frequently Often Always

16. How often do you find yourself saying “just a few more minutes” when playing video games?

0-----------------1-----------------2-----------------3-----------------4---------------
---5

Not at all Rarely Occasionally Frequently Often
Always

17. How often do you try to cut down the amount of time you spend playing video games and fail?

0-----------------1-----------------2-----------------3-----------------4---------------
---5

Not at all Rarely Occasionally Frequently Often
Always

18. How often do you try to hide how long you've been playing video games?

0-----------------1-----------------2-----------------3-----------------4---------------
---5

Not at all Rarely Occasionally Frequently Often
Always

19. How often do you choose to spend more time playing video games over going out with others?

0-----------------1-----------------2-----------------3-----------------4---------------
---5

Not at all Rarely Occasionally Frequently Often

Always

20. How often do you feel depressed, moody, or nervous when you are not playing video goes, which goes away once you are back playing?

0------------------1------------------2------------------3------------------4---------------

---5

Not at all Rarely Occasionally Frequently Often

Always

APPENDIX C

Problematic Video Game Playing Scale (PVP)

Please indicate whether or not each item describes you:

1. When I am not playing video games I keep thinking about them, i.e. remembering games, planning the next game, etc.

   YES NO

2. I spend an increasing amount of time playing video games

   YES NO

3. I have tried to control, cut back or stop playing; OR I usually play video games over a longer period than I intended

   YES NO

4. When I can't play video games I get restless or irritable

   YES NO

5. When I feel bad, e.g. nervous, sad or angry; or when I have problems, I play video games more often

   YES NO

6. When I lose in a game or I have not obtained the desired results, I need to play again to achieve my target

   YES NO

7. Sometimes I conceal my video game playing, or the extent of my video game playing to others, such as parents, friends, colleagues or partners

   YES NO

8. In order to play video games, I have skipped classes or work, or lied, or stolen, or had an argument or a fight with someone

YES NO

9. Because of the video game playing I have reduced my homework, or schoolwork, or I have not eaten, or I have gone to bed late, or I spent less time with my friends and family

YES NO

APPENDIX D

Gambling Related Cognition Scale, adapted for video game use

Please indicate (by circling) the extent to which you agree with the value expressed in each statement (1 = strongly disagree; 2 = moderately disagree; 3 = mildly disagree; 4 = neither agree or disagree; 5 = mildly agree; 6 = moderately agree; 7 = strongly agree)

Illusion of control

"Praying helps me win."

"Specific conditions within video games can help increase my chances of winning."

"I collect specific objects in real life that help increase my chances of winning."

"I have specific rituals and behaviors that increase my chances of winning."

Predictive control

"Losses in video games are bound to be followed by a series of wins."

"A series of losses will provide me with a learning experience that will help me win later."

"When I have a win once, I will definitely win again."

"There are times that I feel lucky, and thus play video games those times only."

"I have some control over predicting my video game wins."

"If I keep changing my [strategy], I have less chance of winning than if I keep the same [strategy] every time."

APPENDIX E

Brief Locus of Control Scale

Please circle a number that best represents your opinion about the following statements.

(1 = strongly disagree, 7 = strongly agree)

1. My life is determined by my own actions.
2. I am usually able to protect my personal interests.
3. I can pretty much determine what will happen in my life.
4. To a great extent, my life is controlled by accidental happenings.
5. Often, there is no chance of protecting my personal interest from bad luck happenings.
6. When I get what I want, it's usually because I'm lucky.
7. People like me have very little chance of protecting our personal interests where they conflict with those of strong pressure groups.
8. My life is chiefly controlled by powerful others.
9. I feel like what happens in my life is mostly determined by powerful people.